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Strategies to Reduce Energy Use for Commuting by Employees

Anantha Lakshmi Paladugula[a], Sujaya Rathi[a],[1]

[a]*Centre for Study of Science, Technology and Policy, Dr. Raja Ramanna Complex, Raj Bhavan Circle, High Grounds, Bangalore- 560001, India*

Abstract

In the last decade, there has been a paradigm shift in the realisation of the environmental costs of transport, on a societal level and the failure of supply side infrastructure to reduce congestion and its negative impacts. Studies show urban areas with a population above 8 million, consume on an average 16,000 million litres of fuel daily. Cars and two-wheelers contribute to a majority of consumption, accounting for approximately 60 to 90 per cent of the total emissions produced by all modes of transport in various types of cities. This situation will be aggravated (more than twice the current fuel usage), if we continue the paradigm of satisfying increased travel demand with increased capacity. Travel Demand Management (TDM) strategies become imperative in this context. Work trips contribute to a major share of the trip profile in major cities and in Bangalore they constitute about 58 per cent. The paper summarizes the anticipated impact of work commute reduction strategies by a single organisation in Bangalore, in terms of vehicle kilometres travelled and energy use. The work trip profile of employees in an organisation is analysed, to understand the travel behaviour. This paper reviews existing research on policies and programs to reduce energy use and greenhouse gas emissions and discusses the possible impacts of various strategies based in the survey responses.

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Keywords: Travel demand management; organisation; employee

1. Introduction

Increasing trips, longer trips, increasing number of vehicles, less walking trips, reduced public transit usage, decreasing air quality and increasing accidents is the current urban scenario in India. This problem needs to be addressed at source, by decreasing the demands for mobility, reducing the number of trips and also the length of trips. Like many other cities across the world, India needs to adopt the "Avoid, Shift and Improve" (AIS) strategy in transport planning in order to be sustainable (Cornie, 2009). This paper highlights the "Avoid (reduce demand

[1] * Corresponding author. Tel.: +91-080-4249-0000; fax: +91-080-2237-2619.
E-mail address: lakshmi@cstep.in

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for mobility), that need to be addressed in tandem with the "Shift (from personal vehicles to public transport and non-motorized modes) and "Improve (efficient and clean vehicles). This paper also illustrates trip reduction strategies that can reduce vehicle trips.

India's vehicle population has experienced a tremendous growth from 0.3 million in 1951 to 141.8 million in 2011. Currently two-wheelers and four wheelers (cars, jeeps, and taxis) contribute to about 86 per cent of the total vehicle population. The transport sector contributes to about 7.5 per cent of the greenhouse gas emissions. Out of these emissions, the road transport sector contributes to about 87 per cent (MoEF, 2007). The emission of CO2 on Indian roads is expected to reach 1212 million tonnes by 2035 from a value of 208 million tonnes in 2005 (CPCB, 2010).

Indian cities are engines of economic activity and have a major contribution in the development of the country. But they are currently overwhelmed by congestion and the associated costs to all sections of the society. As a result of increased motorization, the local air quality is deteriorating, resulting in serious health implications and significantly higher accident rates. For example, Delhi, Bangalore, Chennai, Hyderabad, Pune and Greater Mumbai account for about 14 per cent of the total number of registered vehicles in India. As per the National Ambient Air Quality Report (MoEF, 2011)the number of non- attainment (prescribed National Ambient Air Quality Standards (NAAQS) are violated) states, cities and metropolitan cities is as listed below:

Table 1. Summary of non – attainment number of states, cities and metropolitan cities in India (MoEF, 2011)

Emissions type (National Ambient Air Quality Standard)	States (26*)	Cities (142*)	Metropolitan Cities (35*)
PM (60 $\mu g/m^3$)	22	96	33
NO_2 (40 $\mu g/m^3$)	3	10	7
SO_2 (50 $\mu g/m^3$)	0	0	0

*Number considered for National Ambient Air Quality Study

It is evident from the statistics above that there is no compliant with the emission standards in the states, cities and metropolitan cities level. The major source of pollution in non-attainment cities is contributed from vehicles. This if left unchecked, will seriously hamper economic growth, travel time and costs impacting productive capacity of the city and the quality of life. Travel demand management measures play a crucial role in this context.

2. Travel Demand Management

TDM strategies aim to reduce the demand for automotive travel, especially during peak hours. Some TDM options are voluntary, while others are enforced through regulations and still others rely on prices to reduce automotive demand (Paul S et al., 2008). TDM as a strategy aims at reducing demand for single occupancy vehicle use. Strategies such as ride-sharing, flexible work hours, congestion pricing, voluntary or incentive-based programmes are intended to reduce and manage travel demand.

One of the early TDM employer program in the 1920's in US was initiated by Reader's Digest to subsidize a private bus system (from Manhattan to Westchester County, NY) to transport relocated workers. Other examples include the Tennessee Valley Authority programme to reduce parking demand and the 3-M Company in the Twin Cities of Minnesota and Minneapolis, founder of employer-sponsored vanpooling. The energy crises in the mid- and late-1970's prompted a significant number of new programs like public efforts to promote ridesharing by employers. Employers play a critical role in effective transportation control measures. In order to reduce peak period trips from the point of view of improving both air quality and traffic congestion, one needs to look at the trips to work site (EPA, 2012). Trip reduction results for employer based transportation management programme are given below:

Table 2. Employer based transportation management program (EPA, 2012)

Employer	Vehicle trips (without programme)	Vehicle trips (with programme)	Daily vehicle trips reduced	Daily VMT* reduced	Annual VMT reduced	Per cent reduction of trips & VMT
US WEST Communications	994	520	474	18012	4683120	47
University of California, Los Angeles	15048	14220	824	26496	6888960	5
Nuclear Regulatory Commission	1334	752	582	12571	3268512	43

*VMT –Vehicle Miles Travelled

In Wisconsin promoting a free carpool and bicycle buddy match program is estimated to achieve 57.4 million vehicle miles state wide. The Commute Trip Reduction program (CTR) in Washington State, witnessed the drive alone rate dropped from 68.2 to 61.6 per cent, leading to a reduction in fuel consumption by 7.9 million gallons and air pollution by 4000 tonnes in 2007. In 2011 the Trip Reduction Program (TRP) in Maricopa County, resulted in saving 14,764 tonnes of pollution by using an alternative mode of transportation (MIP, 2012). For similar reasons, EMC Corporation encourages e - conferencing, virtual meetings, remote work assignment and shuttle services (EMC, 2011).

The selected TDM strategies should demonstrate long-term benefits and offer flexibility. Some of the strategies to reduce travel demand are listed below:

- Vehicle Miles Reduction – Carpooling/Vanpooling, park and ride facilities, amenities within the organisation (shopping, day care, library, food outlets etc.)
- Policy measures – Parking fees at work places, trip reduction policy, alternate or flexible work schedule, restricting single occupancy, support clean fuel technologies
- Use of Intelligent Transportation Systems (ITS) for information and decision making
- Improve public transport (connectivity, comfort, last mile connectivity and reliability)
- Land use – Transit oriented demand, Multimodal connectivity, development of non-motorized transport and infrastructure

Policies, Acts & Ordinances

In the US, the passage of the National Environmental Policy Act in 1969 contributed to the emphasis on TDM. The Clean Air Act Amendments (CAAA) of 1970 and 1977 in the US required transportation control plans for areas unable to meet air quality standards despite new automobile emission regulations. The fuel shortages of 1973–1974 added the goal of energy conservation to emission reductions. U.S. DOT regulations in 1981 required that priority for transportation funds in nonattainment areas be given to transportation (air quality) control measures (TCM) in state air quality implementation plans (DOE, 2013).

Air Quality Bill, 1988 in Maricopa County, Arizona as a policy initiative, requires all major employers to develop, implement and maintain a travel reduction program. The CTR program was part of the State law in Washington which had to be adopted by employers having 100 or more employees at a worksite (MIP, 2012). California's parking cash-out law requires certain employers who provide subsidized parking for their employees to offer cash allowance in lieu of a parking space (Parking Cash – out law, 2009).

3. Case Study

The focus of this paper is to analyse the impact of work trips froma service based organisation in Bangalore on emissions and energy consumption and highlight the role that organisations can play in work trip reduction and need for commute trip reduction programs or policies in Indian cities. The concept is not new and is practised in the developed countries since the 1920's and travel reduction ordinances since 1970's, but in developing countries like India, it is still at an informal level, and thus the impact is negligible. In India, private corporations, like Accenture have launched a carpool portal that now has about 18,000 registered employees, aimed at helping colleagues find carpool partners and save on fuel and auto maintenance while reducing carbon emissions (Working Sustainably, 2013).

Work trips in the major metropolitan cities of India constitute approximately 40-50 per cent (Dinesh M, 2002). The following section illustrates the methodology and tools required to evaluate travel behaviour of employees. It assesses the current mode share, personal vehicle usage, energy consumption and emissions by work trips of employees in an organisation. It then explores some TDM strategies relevant for the organisation and evaluates their impact on energy consumption and emissions. The paper concludes highlighting the need and role of policy in this context.

Methodology

This section includes an overview, of the methodology and tools used for analysing the impact of employee travel behaviour on emissions and energy. The travel behaviour of employees needs to be considered during peak hour demand estimates and corresponding traffic management measures. The measure of employee trips, to and from an organisation determines the major travel behaviour in urban areas. The type and quality of transport service and information on a route influences the travel behaviour. In general commuters make random decisions on departure time to work to avoid the peak hour traffic. As most of the work trips are predetermined, these trips are to be routed effectively.

Data collection was done by conducting a work travel survey in the organisation for information on: mode of transport to work, travel cost, travel time, maintenance cost in case of personal vehicle, fuel type and preferred mode of transport. (Appendix A). A travel analysis model has been used in conjunction with an emissions factor model to estimate energy and emissions. The major outcomes considered from survey data analysis are: personal vehicle kilometres, energy consumption and emissions.

Using the GIS tool (ArcGIS 10), the shortest path between home location of employees and organization location was plotted, and potential car-pooling routes were identified for testing strategies. The strategies were evaluated for the change in vehicle kilometres travelled (VKT), energy consumption and emissions. The strategies considered for this study are: 1) work from home or telecommuting, 2)compressed work week, 3) carpooling/vanpooling and 4) combination of 1, 2 and 3.

This study gives us an understanding on energy use and consequent emissions for work trips in an organisation. The study explores the possibilities of making the work trips more efficient in terms of fuel usage and emissions. Testing some strategies of TDM shows the variation in energy and emissions by adopting a single strategy or a combination of strategies.

4. Data Analysis

An online survey questionnaire was circulated to all the employees in the organisation. Out of the 70 employees in the organisation 80 per cent of the employees took part in the survey (sample size: 56). The data collected was analysed for the share of public transport usage, private vehicle usage, fuel type used in personal vehicle, energy consumption per vehicle etc.

Mode Choice: 54 per cent of the employees use personal transport and 32 per cent use public transport. 59 per cent of the employees fall in the age group of 20-30. 50 per cent of the employees depart to work from 8.00 – 9.00 A.M and 59 per cent leave from 5-6 P.M. 39 per cent of the employees commute by multiple mode of transport (combination of private vehicle, auto rickshaws, walk, public transport and company vehicle).

Reasons for choice of mode: Based on the analysis, it was observed that employees use public transport due to affordability, safety and when there is no other mode of transport. Whereas employees using personal transport are of the opinion that it is comfortable, reliable (time factor), affordable and safe.

Impacts of the mode choice: It was calculated that the travel for work by employees was over 1.2 lakh vehicle kilometres annually consuming 4080 litres of petrol and 860 litres of diesel. Details are shown in Table 3.

Table 3. Yearly Fuel Consumption by Personal Vehicles

Vehicle type	Fuel type	Vehicle kilometres travelled yearly	Fuel consumption per km travel (litres)	Fuel consumption yearly (litres)
Two Wheeler	Petrol	74844	45	1670
Four Wheeler	Petrol	33726	14	2410
Four Wheeler	Diesel	12012	14	860

Source: Authors

Two-wheelers are the preferred mode of personal transport among the employees (60 per cent). In the fuel used in personal vehicles, share of petrol is about 90 per cent.

4.1. GIS Analysis

A GIS tool is used to visualize and analyse the travel behaviour of employees. Understanding the daily trips of employees has important implications on the traffic pattern in an urban area. The capabilities of GIS can be used to manage the travel demand management strategies. This GIS tool can be used to explore the travel behaviour of multiple organisations in the city. GIS can be used to validate the effectiveness of travel demand management strategies and supports decision making. Providing travel behaviour information in a GIS framework will help employers to effectively plan employee trips. In this study the GIS tool is used to plot employee home locations as well as organisation location and is analysed for the shortest path. This tool is helpful to plan car-pool/shuttle routes, suitable for small/large samples.

4.2. Strategies

Based on the current status of VKT, energy consumed, mode of transport and emissions, travel demand strategies are tested. Apart from the Business As Usual (BAU) scenario, 3 strategies are tested with respect to personal vehicle use. The anticipated impacts of the strategies are discussed below:

4.2.1. Business As Usual (BAU)

In this scenario the employee trips remain the same with respect to number of trips and mode of transport. The number of VKT by personal vehicle with a total fuel usage (litres) and the resulting emissions per year was calculated. The emission factor (ARAI, 2007) is considered based mode wise travel.

Table 4.Business As Usual (BAU)

Travel Demand Management strategies	No of working days	Vehicle kilometrestra velled	Total energy usage (litres)	Total emissions (CO2 tonnes)	Vehicle kilometres/Energy/Emissions reduction (%)
Business As Usual (BAU) (*only 30 employees)	231	120582	4740 (petrol & diesel)	11	NA

Source: Authors

4.2.2. Strategy 1: Work from home or telecommuting

If employees are given an option to work from home one day in a month, then total 12 days in a year employees are allowed to work from home and thus 24 trips per employee can reduce.

Table 5. Strategy 1 vs. Business As Usual

Travel Demand Management strategies	No of working days	Vehicle kilometres travelled	Total energy usage (litres)	Total emissions (CO2 tonnes)	Vehicle kilometres/Energy/Emissions reduction (%)
Business As Usual (BAU)	231	120582	4740	11	NA
Strategy 1 (Work from home)	219	114318	4683	10.4	5

Source: Authors

In comparison to BAU scenario, there was a 5 per cent reduction in the vehicle kilometres travelled, energy consumption and emissions.

4.2.3. Strategy 2: Compressed work week

The number of working days in a week was reduced from 5 to 4 with an increase in the number of working hours. Reduced vehicle trips per person 96 trips (assumed 48 days in a year)

Table 6. Strategy 2 vs. Business As Usual

Travel Demand Management strategies	No of working days	Vehicle kilometres travelled	Total energy usage (litres)	Total emissions (CO2 tonnes)	Vehicle kilometres/Energy/Emissions reduction (%)
Business As Usual (BAU)	231	120582	4740	11	0
Strategy 2 (Compressed work week)	183	95526	3913	8.7	26

Source: Authors

In comparison to BAU scenario, there was a 26 per cent reduction in the vehicle kilometres travelled, energy consumption and emissions.

4.2.4. Strategy 3: Carpooling/Vanpooling

From the routes identified using the GIS analysis employees in close proximity are car pooled or van pooled depending on the number of employees. The longest distance travelled by an employee is considered as vehicle kilometres travelled. The shortest path algorithm is tested for all the employee home locations from the organisation location and co- employees in close proximity was considered for one of the strategies. Based on the analysis, 6 routes were identified for testing the strategies.

Table 7. Strategy 3 vs. Business As Usual

Travel Demand Management strategies	No of working days	Vehicle kilometres travelled	Total energy usage (litres)	Total emissions (CO2 tonnes)	Vehicle kilometres/Energy/Emissions reduction (%)
Business As Usual (BAU)	231	120582	4740	11	0
Strategy 3 (Carpooling/Vanpooling)	231	90125	3692	8.2	33

Source: Authors

It was analysed that by adopting the carpooling/vanpooling strategy there will be a 33 per cent reduction in vehicle kilometres travelled by employees in comparison to BAU scenario. The route wise savings in vehicle kilometres is given below:

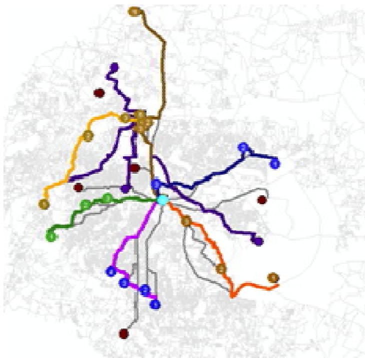

Fig. 1. Routes identified for carpooling employees

Table 8. Route wise vehicle kilometres savings

Route	Vehicle kilometres (Current)	Vehicle kilometres savings
1	8607	2426
2	13971	7896
3	10538	4334
4	14987	7623
5	9439	3678
6	9831	4500

Source: Authors

The reduction in vehicle kilometres travelled, energy consumption and emissions are given in the table below:

Table 9. Strategies comparison

Travel Demand Management strategies	No of working days	Vehicle kilometres travelled	Total energy usage (litres)	Total emissions (CO2 tonnes)	Vehicle kilometres/Energy/Emissions reduction (%)
Business As Usual (BAU)	231	120582	4740	11	0
Strategy 1 (Work from home)	219	114318	4683	10.4	5
Strategy 2 (Compressed work week)	183	95526	3913	8.7	26
Strategy 3 (Carpooling/Vanpooling)	231	90125	3692	8.2	33
Strategy (1 & 3)	219	85443	3500	7.8	41
Strategy (2 & 3)	183	71397	2924	6.5	69

Source: Authors

5. Conclusion

As work trips contribute to a major share of commuter trips in the Indian cities, the analysis of travel behaviour of employees is essential. A policy measure to reduce energy consumption and emissions from work trips should be promoted either by employers or by urban local bodies. The limitations of the traditional sampling techniques for preparation of transportation plans or mobility plans have to be tackled by efficient trip data collection techniques.

The overall travel behaviour of commuters in the urban areas provides better understanding of the infrastructure demand. Depending on the travel behaviour of employees in an organisation and in the neighbourhood, trip reduction strategies can be planned effectively. The observations from the study are listed below:

- Personal vehicle kilometres travelled by carpooling is comparatively less than the personal vehicle kilometres travelled by reduction in number of working days (strategy 1 & 2)
- Independent strategies result in 5 to 33 per cent savings with respect to current personal VKT
- Combination of strategies result in 41 to 69 per cent savings with respect to current VKT
- Less personal VKT by employees, result in less energy use and less emissions

As seen from a single case study, combined strategies for work trip reduction has the potential to substantially reduce GHG emissions in three aspects. They include: substantial average reductions in vehicle kilometres travelled after a participant joins the car-pool program in the organisation; shared vehicles are generally more fuel efficient than the existing vehicle fleet, and since employees drive fewer kilometres and vehicles are used more intensively, sharing reduces the number of cars needed, which, in turn, reduces energy used and emissions emitted in operation of vehicles.

6. Policy Options

In India, trip reduction strategies can be utilized as a mechanism for managing congestion and related problems such as air pollution, and obtaining private sector participation in traffic management efforts. These policies need to be part of a package of transportation control strategies which will enable urban areas to attain ambient air quality standards.

The trip reduction policies/guidelines could be set by ward committees (ward level), urban local bodies, or state government requirements. The focus of the policies needs to be on work trips and/or on peak period work trips and this could be aimed at developers of commercial properties and/or employers. These policies need to be supported by other government commitments to develop and implement supportive Transportation System Management (TSM) measures such priority for high occupancy vehicles lanes, and other incentives. When peak-period travel is the major concern, programs such as flexitime and staggered work hours, off-peak scheduling of deliveries and other peak reducing methods may be encouraged in addition to strategies to facilitate trip reduction.

Motivating factors for Urban Local Bodies (ULBs) or states to adopt trip reduction policies may include financial difficulties in adding new transportation capacity to meet demand; the lag time in getting transit improvements in place; citizen concerns about the social and environmental impacts of such capacity expansions; and, particularly in areas experiencing rapid growth, citizen pressures to minimize traffic impacts associated with new development. Policies may have many variations based on:

1. Range from those that encourage voluntary to mandatory provision of commute alternativesinformation and incentives at the workplace, including the creation of an outreach program to work with interested employers and their employees.
2. Meeting the ambient air quality standards for an area and/or a city.
3. Incorporation of trip reduction measures to the conditions of approval for all new development projects (at least those over a certain size). For example, a construction permit may require establishment of on-site parking spaces for high-occupancy vehicles; an occupancy permit may require an on-site transportation coordinator. The specific requirements may be set forth in an ordinance, regulation, or policy statement, or may be negotiated case by case.
4. Requirements that all developments and all existing and new employers over a certain size develop and implement demand management programs such as carpooling, flexitime and subsidies for users of commute alternatives. Specific actions may be mandated, e.g., preferential parking for carpools, the imposition of parking charges for solo drivers, or a performance standard may be used and e.g., not less than 30 per cent of employees in commute alternatives.

As the list above suggests, there is a considerable range in the breadth of applicability, the degree of compulsion, and the level of detail involved in the various approaches. Some local governments may utilize several approaches immediately (e.g. apply one set of trip reduction requirements to major new developments, another to smaller new developments, and yet another to existing employer).

Limitations of the methodology include a small sample, but it highlights the impact of sustainable work commute options. This study will need to be extended with willingness to the options from the organisations as well as the employees for more realistic impacts.

Future work on this could entail development of an **assessment tool** to assess the scalability of this methodology for other organisations, especially in high activity zones like industrial areas, IT corridors and institutional areas, etc. In addition **network of organisations** interested in reducing traffic congestion, parking demand and promote sustainable work commute options, in order to work towards, a **"Smart Work Commute Policy"** can be built.

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References

Ministry of Road Transport & Highways (MORTH). (2000). Report of the Sub-Group on passenger and freight traffic assessment and adequacy of fleet and data collection and use of IT in transport sector in the Twelfth Five Year Plan (2012-17).

Singh, S.K. CO2 Emissions from passenger transport in India: 1950-51 to 2020-21

Akshima,T.Ghate.,&Sundar, S. (2013). Can we reduce the rate of growth of car ownership?,*Economic & Political Weekly* XLVIII – 23

Cornie, H. (2009). Asia Development Bank (ADB). Clean Air Initiative for Asian Cities Center. Proposed action plan to make transport in developing countries more climate friendly.

Ministry of Environment and Forests (MoEF). (2007). Indian Network for Climate Change Assessment (INCCA). India: Greenhouse gas emission

Central Pollution Control Board (CPCB). (2010). Status of the vehicular pollution control programme in India

Ministry of Environmental &Forests (MoEF). (2011). National Ambient Air Quality Monitoring Status (NAAQMS). 2009.

Paul, S., Martin W., Endy, Y. M., Aaron, K., Liisa, E., Mark, H et al. (2008). Transportation, Space and Technology – A RAND infrastructure, safety and environment program – Moving Los Angeles – Short term policy options for improving transportation.

Environmental Protection Agency (EPA).(2012). Employer - Based transportation management program.http://www.epa.gov/otaq/stateresources/policy/transp/tcms/emplyer_transmgt_prog.pdf

Mobility Investment Priorities Projects (MIP). (2012). Texas A&M Transportation Institute, State employee trip reduction.http://mobility.tamu.edu/mip/strategies_pdfs/travel_options/technical_summary/state-employee-trip-reduction-4-pg.pdf

EMC (2011).http://www.emc.com/corporate/sustainability/sustaining-ecosystems/commuting.htm

U.S Department of Energy (DOE). (2013). Energy Efficiency & Renewable Energy, Effects of travel reduction and efficient driving on transportation: Energy use and greenhouse gas emissions- *Transportation Energy Future Series*.

California Environmental Protection Agency, Air Resources Board, Parking Cash – out law (2009). California's parking cash – Out program.

Working Sustainably, Accenture, 2013.http://www.accenture.com/microsites/corporate-citizenship-report-2012/environment/Pages/working-sustainably.aspx

Dinesh, M., (2002). Work trips and safety of bicyclists. *Indian Journal of Transport Management.*

Trip reduction ordinances.http://www.epa.gov/otaq/stateresources/policy/transp/tcms/trip_reduction.pdf

Jose, R., & Tom, M., (2009). Travel demand management, strategy paper.

Trip Reduction Ordinances.http://www.nctr.usf.edu/clearinghouse/tro/trolist.htm

The Automotive Research Association of India.(ARAI).(2007). Emission factor development for Indian vehicles.

Mergu, D., Prabhakar, B., Rama, N., (2009). An incentive mechanism for decongesting the roads: a pilot program in Bangalore, Proceedings of NetEcon '09, ACM Workshop on the Economics of Networked Systems.

Appendix A. Survey Questionnaire

Survey Questionnaire for Work Travel Behaviour														
I	Gender (Mark 1 for the group chosen)													
	Male	Female												
II	Age (Mark 1 for the group chosen)													
	20-30	30-40	40-60	>60										
III	Trip Summary (address /nearest landmark, area and pin code)													
	From (address)	Home #		Pin Code										
	Time of departure to work		Time of leaving from work											
IV	Mode of Transport (Mark 1 for modes chosen)													
	Two Wheeler	Car/SUV	Bus	Auto/Taxi	Train (Intercity)	Metro (Intra city)	Bicycle	Walk	Private Bus	Company Vehicle	Sharing Vehicle (Bike, Car)	Other means		
V	Work timings													
	IN	OUT												
VI	Trip Parameters													
	Average Travel Distance (KMS)	Average Travel Time (Minutes)	Average Waiting Time (Minutes)	Average Travel Cost (Rs.)	Insurance cost (Rs.)	Annual Maintenance cost (Rs.)	Fuel Type	Fuel cost (Rs.)	Vehicle Age	Fuel usage per month	No. of vehicles owned	No. of intra city office trips	Vehicle manufacturing year	Emission standard
VII	What is the reason for your mode choice? (Mark 1 for the ones you choose)													
	Safe	Affordable	Comfortable	Reliable	No other transport choice	Any other reason please specify								
VIII	What is your preferred mode choice to work? (Rank, 1, 2, 3-1 as first choice)													
	Personal Vehicle	Public Transport	Company Transport											
IX	Do you travel by Public Transport? Yes- 1, No -0													
X	Why do you travel by Public Transport? If yes for 11, (Mark 1 for the ones you choose)													
	Safe	Affordable	Comfortable	Reliable	No other ansport hoice	Any other reason please specify								